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54 **Temperature release containers.**

57 Temperature Release Containers for dispensing a liquid or powder fabric conditioner wherein the container (20, 40) is caused to break or detach in response to temperature change, either by constriction or expansion of a thermo-responsive element (24, 44) or by use of a two-part container (50, 60) wherein the degree of contraction of a first part (51, 61) in cold rinse water of a washing machine is substantially greater than the second part (54, 62), whereby the latter detaches from the first part. Thus, when a container of this type is placed in a clothes washer, the washing cycle is set to a warm or hot temperature and the final rinsing cycle is set to cold. The cold water causes the container to break or to separate, so that the conditioner is released into the rinse water.

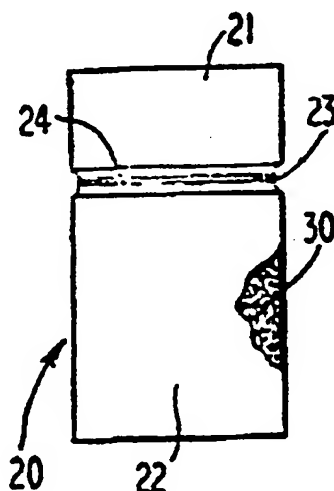


Fig. 1

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TEMPERATURE RELEASE CONTAINERS

The purpose of this invention is to provide means for delivering fabric conditioners to clothes, fabrics and other textile materials (for ease of reference, such items are referred to herein as "clothes") which are washed in washing machines. (Herein, unless stated otherwise, "conditioner" and "conditioners" include fabric softeners, anti-static agents, deodorants, perfumes and other fabric conditioners. Fabric softeners are the primary concern of this invention.)

Virtually everyone is aware of the pleasing feel and effect a truly soft towel, shirt, pair of socks, undergarment, etc. has when brought into contact with their body. However, when such items are washed with current detergents, the softness quickly disappears and the items become coarse. (Herein, "detergents" include soaps as well as detergents.) This is probably a result of mineral deposits, precipitation of certain components in the detergents and other factors.

Attempts to avoid such coarseness have been made by adding fabric softeners to detergents, such as by mixing dry or liquid detergents and softeners. This approach has also proven to be unsuccessful and can even increase the coarseness. One explanation for the latter result can be found in U. S. Patent 4659496 (Amway Corporation):

"Most fabric softeners/antistatic compounds provide softening and antistatic action by depositing cationic particles onto fabric surfaces. They impart desirable qualities such as pleasing, tactile properties, reduction of static electricity and the adherence of dirt and dust particles, reduction of fabric wrinkles and generally permit treated fabrics to be more easily separated following the drying cycle. Typically, fabric softeners/antistatic contain a cationic quaternary ammonia compound. These positively charged particles, however, interfere with anionics soil components as well as with anionic surfactants which are present in many conventional detergent compounds. This charge attraction between cationic and anionic components forms unwanted precipitates which may accumulate on fabric surfaces commonly in the form of redeposited soil. In order to eliminate this source of interference, it is desirable to keep anionic and cationic components separated during the laundering process." (Emphasis supplied.)

The art has long sought a satisfactory solution to the above problem. While the art has developed a large number of softener and other conditioning agents (described below), none have worked properly when mixed or otherwise packaged with detergents. The only known method of achieving acceptable conditioning is, as mentioned above, that of introducing the conditioner separately into the washing machine by hand after the detergent has been rinsed out--and this method is, quite obviously, impracticable for most persons.

To explain, some years ago, certain automatic washing machines had devices designed to release conditioners at the "right" time, i.e., after the detergent had been rinsed away the the first rinse cycle. Such machines then released the conditioners during the second rinse cycle. In this manner, the conditioners did not react with the detergent and, moreover, the conditioners were thereby allowed to permeate the clothing. Consequently, the clothing, when dried, were very soft and, when anti-static agents were included (as is usually the case)-free of static cling.

For whatever reason, few if any automatic washers currently sold have such conditioner delivery devices. Accordingly, manufacturers of detergents have been forced to use other modes of introducing conditioners into washing machines. (There are several companies in the United States which continued to sell liquid conditioners. However, such conditioners can only be properly used if the person washing his or her clothes has a timer or sits and watches the automatic washer until it begins its second rinse cycle to pour the conditioners in. Alternatively, the person can wait until the washer completes all cycles and shuts down, at which time the person can pour the conditioner onto the clothes, move the control to the second rinse and re-start the machine--all at a waste of time and convenience. Since this is impractical for almost everyone, especially with so many women working, the bottled liquid (or diet) conditioners now on the U. S. market which, by their own labels require their conditioners be introduced only after the first rinse, do not solve the delivery problem.

A number of companies have simply mixed conditioners with detergent. See, for example, U.S. Patent 3936537. None of these mixtures provides adequate conditioning. Indeed, the clothes so treated are harsh to the touch, undoubtedly because the conditioners react with the detergents to form precipitates.

Companies have also attempted to solve the problem by impregnating conditioners on or within pouches or on conditioner sheets for use in the washer and/or the dryer. See U. S. Patents 4,733,744 and 4,659,496; 4,229,475; 4,229,475; 4,308,306; 3,686,025; 4,255,484; 3,936,538; 3,632,396; 4,356,099; 4,389,448; 4,659,496; and 3,896,033. These do not condition clothes adequately. Those configurations which mix detergents and conditioners suffer from the drawbacks noted above. In addition, the highly promoted "dryer sheets"--which are impregnated with conditioners--are very inadequate. Undoubtedly, this is due in part to

the fact that a small sheet in a large mass of clothes in a tumble dryer simply cannot release enough conditioners--especially softeners--to improve feel.

Another approach is exemplified by U. S. Patents 4082678 and 3947971. The '678 Patent discloses a so-called "inner receptacle" containing the conditioners which "serves to prevent the fabric conditioning composition from being released to the fabrics until the rinse cycle of the washer and the drying cycle of the dryer. The receptacle thus must have at least a part of one wall which is water soluble/dispersible but is insolubilized during the wash cycle by the maintenance of a sufficient electrolyte level and/or the appropriate pH." (Col 6, lines 33-40) It is not believed that the system of the '668 Patent ever reached commercial success.

The '971 Patent disclose a softener in a tablet which is encased in sheets. Again, it is believed that this system was never successful. See also U. S. Patent 4348293.

Thus, prior systems do not adequately perform as means to deliver conditioners.

As will be seen, there are a large number of effective conditioners which have been developed by the art. However, particularly with respect to softeners, the technical problem is--and has been--to deliver the softeners into the rinse water of the washing machine after the detergent has been substantially flushed out of the water in order to avoid the reaction between components of the conditioners and components of the detergent.

Stated in a non-limiting way, the solution to the technical problem is set forth by the present invention. Thus, generally, instead of mixing conditioners and detergents in pouches, etc., or impregnating them onto sheets for the washer, or impregnating conditioners onto dryer sheets, the present invention presents a radical departure from such unworkable delivery systems.

Accordingly, broadly described in a non-limiting fashion, this invention provides a new methods for conditioning clothes and novel containers for conditioners. In all embodiments, the containers of this invention open in a washing machine when the hot or warm wash water is replaced with cold rinse water.

The basic concept of the methods and containers of this invention is the provision of a container which is either initially constructed with at least one detachable part or component (there could be more) or which may, alternatively, be an integral container which is capable of being broken. The containers are sold full of conditioners, the person washing clothes places the container into the washing machine at the onset of the wash cycle with the detergent and sets the wash cycle to hot or warm, and the rinse temperature to cold. The present containers remain intact during the hot or warm wash cycle, but the detachable part or component separates and releases the conditioner during the cold rinse cycle, thereby completely impregnating the clothes and providing very superior softening and other fabric conditioning effects during the final rinse.

Following that basic concept, there is provided a container which, in one embodiment, has a frangible area which is surrounded by thermoresponsive material, whereby the thermoresponsive material contracts when it is cooled by the cold rinse water and so that its consequent contraction ruptures the frangible material. This, of course, ruptures the container which releases the conditioner into the rinse water at exactly the "right" time, i.e., after the detergent has been removed by the rinse water so that adverse precipitation reactions are prevented and so that the conditioners can adequately permeate the clothing and thus provide optimum softening and other conditioning effects. This is accomplished by placing the container into the washing machine at the beginning of the wash, so that the individual doing the wash does not need to be present.

Another set of embodiments may be generally described as two-part containers, preferably of rigid plastic, wherein one part is made of material which contracts with temperature to a greater degree than the other part. Thus, when the former encounters the cold rinse water, it contracts and separates from the other part. This action, along with the tumbling action of the washing machine, causes the two parts to disassociate so that the conditioners are released into the rinse water.

Other embodiments of the invention will be described below and are illustrated in the drawings.

Figure 1 is a schematic view in elevation of a first embodiment of the Container of this invention.

Figure 2 is also a schematic view, showing the Container having its top and bottom portions separated and the thermoresponsive wire detached.

Figure 3 is a schematic view in elevation of a second embodiment of the Container of this invention.

Figure 4 is also a schematic view, showing the Container having its top and bottom portions separated and the thermoresponsive wire detached.

Figure 5 schematically depicts a third embodiment of this invention wherein the Container is a sphere.

Figure 6 is a sectional view along the lines 6-6 of Figure 5.

Figure 7 is a view of the Container shown in Figure 6 after its component parts have become

disassociated.

Figure 8 is a sectional view of a fourth embodiment of the Container of this invention wherein the two portions of the Container are initially joined by friction fit.

Figure 9 shows the two component portions after their separation.

5 Figure 10 is a fifth embodiment of the Container of this invention wherein the Container is in two parts held together by a material which weakens when immersed in cold washing machine rinse water.

Figure 11 is a sectional view of a sixth embodiment of the Container of this invention wherein a memory element is employed.

10 Figure 12 illustrates the Container of Figure 11 opened to release conditioners under the influence of the memory element.

Figure 13 is a plan view of a thermally responsive memory element having a circular form.

Figure 14 is a plan view of the memory element of Figure 15 in its deformed shape.

Figure 15 is a schematic view in elevation of the eighth embodiment of a Container according to this invention with the memory element of Figure 13 encircled around it.

15 Figure 16 is a schematic view in elevation of the Container of Figure 15 showing the memory element deformed as in Figure 14 to break open the Container to release conditioners into the rinse water of a washing machine.

20 As described above, the fatal flaw with present attempts to condition clothing is that the packages either mix detergents and conditioners which react to coarsen the materials--or by impregnating dryer sheets with conditioners--which just do not work effectively.

Since few persons can sit by their washing machine until the detergent is rinsed out and then add conditioners to the final rinse, the art has completely failed to solve this important technical problem.

The problem is solved by the present invention, as will now be described in detail.

25 As indicated, the present invention provides containers which break or fracture in response to temperature change, including those which have "breakaway" or detachable portion(s). The fracturing or detachment occurs when the container encounters the cold rinse water after warm or hot washing water, i.e., at the "right" time because the detergent is in the process of being rinsed out or has been completely rinsed out.

30 For purposes hereof, including the claims, the term "warm" used to describe the temperature of water in a washing machine during the wash cycle means temperatures in the range of about 110-140 degrees F (43.3-60 degrees C) and the term "hot" means temperature above 140 degrees F (60 degrees C), although these ranges can vary considerably depending upon a particular machine and, of course, the setting of the temperature of the water heater serving the machine. For the same purposes, the terms "cold" and "rinse water" used to describe the temperature of the rinse water in a typical washing machine is in the range of about 40-60 degrees F (4.4-15.5 degrees C), although these temperatures can vary depending upon external factors.

35 In order to achieve this result--and to understand how it occurs--reference must be made initially to the law of thermal expansion. Stated simply, "linear expansivity is the fractional increase in length of a specimen of a solid, per unit rise in temperature." (Concise Science Dictionary, Oxford University Press, 1984.)

40 For some metals, the linear coefficients of expansion are as follows (reproduced from "ASM Metals Reference Book", published by the American Society For metals, 1983):

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LINEAR THERMAL EXPANSION OF METALS AND ALLOYS

	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of expansion μ in./in. °C</u>
	Aluminum and aluminum alloys		
10	Aluminum (99,996%)	20-100	23.6
	Wrought alloys		
15	EC, 1060, 1100	20-100	23.6
	2011, 2014	20-100	23.0
	2024	20-100	22.8
	2218	20-100	22.3
20	3003	20-100	23.2
	4032	20-100	19.4
	5005, 5050, 5052	20-100	23.8
25	5056	20-100	24.1
	5083	20-100	23.4
	5086	20-100	23.9
	5154	20-100	23.9
30	5357	20-100	23.7
	5456	20-100	23.9
	6061, 6063	20-100	23.4
	6101, 6151	20-100	23.0
35	7075	20-100	23.2
	7079, 7178	20-100	23.4
40	Casting alloys		
	A13	20-100	20.4
	43 and 108	20-100	22.0
45	A108	20-100	21.5
	A132	20-100	19.0
	D132	20-100	20.5
	F132	20-100	20.7
50	138	20-100	21.4

	<u>Metal or alloy</u>	<u>Temperature</u> °C	<u>Coefficient of expansion</u> <u>/in./in. °C</u>
5	142	20-100	22.5
	195	20-100	23.0
	B195	20-100	22.0
	214	20-100	24.0
10	220	20-100	25.0
	319,	20-100	21.5
	355	20-100	22.0
15	356	20-100	21.5
	360	20-100	21.0
	750	20-100	23.1
	40E	21-93	24.7
20	Copper and copper alloys		
	Wrought coppers		
25	Pure copper	20	16.5
	Electrolytic tough		
	pitch copper (ETP)	20-100	16.8
30	Deoxidized copper, high		
	residual phosphorus (DHP)	20-300	17.7
	Oxygen-free copper	20-300	17.7
35	Free-machining copper 0.5%		
	Te or 1% Pb	20-300	17.7
	Wrought alloys		
40	Gilding 95%	20-300	18.1
	Commercial bronze, 90%	20-300	18.4
	Jewelry bronze, 87.5%	20-300	18.6
45	Red brass, 85%	20-300	18.7
	Low brass, 80%	20-300	19.1
	Cartridge brass, 70%	20-300	19.9
50	Yellow brass,	20-300	20.3
	Muntz metal	20-300	20.8

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	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of expansion μin./in. °C</u>
6	Leaded commercial bronze	20-300	18.4
	Low-leaded brass	20-300	20.2
	Medium-leaded brass	20-300	20.3
	High-leaded brass	20-300	20.3
10	Extra-high-leaded brass	20-300	20.5
	Free-cutting brass	20-300	20.5
	Leaded Muntz metal	20-300	20.8
	Forging brass	20-300	20.7
15	Architectural bronze	20-300	20.9
	Inhibited admiralty	20-300	20.2
	Naval brass	20-300	21.2
20	Leaded naval brass	20-300	21.2
	Manganese bronze (A)	20-300	21.2
	Phosphor bronze, 5% (A)	20-300	17.8
	Phosphor bronze, 8% (C)	20-300	18.2
25	Phosphor bronze, 10% (D)	20-300	18.4
	Phosphor bronze, 1.25%	20-300	17.8
	Free-cutting phosphor bronze	20-300	17.3
30	Cupro-nickel, 30%	20-300	16.2
	Cupro-nickel, 10%	20-300	17.1
	Nickel silver, 65-18	20-300	16.2
35	Nickel silver, 55-18	20-300	16.7
	Nickel silver, 65-12	20-300	16.2

Copper and copper alloys

40

Wrought alloys

45	High-silicon bronze (A)	20-300	18.0
	Low-silicon bronze (B)	20-300	17.9
	Aluminum bronze (3)	20-300	16.4
	Aluminum-silicon bronze	20-300	18.0
50	Aluminum bronze (1)	20-300	16.8
	Beryllium copper	20-300	17.8

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	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of expansion μin./in. °C</u>
5	Casting alloys		
	88Cu-8Sn-4Zn	21-177	18.0
	89Cu-11Sn	20-300	18.4
10	88Cu-6Sn-1.5Pb-4.5Zn	21-260	18.5
	87Cu-8Sn-1Pb-4Zn	21-177	18.0
	87Cu-10Sn-1Pb-2Zn	21-177	18.0
15	80Cu-10Sn-10Pb	21-204	18.5
	78Cu-7Sn-15Pb	21-204	18.5
	85Cu-5Sn-5Pb-5Zn	21-204	18.1
	72Cu-1Sn-3Pb-24Zn	21-93	20.7
20	67Cu-1Sn-3Pb-29Zn	21-93	20.2
	61Cu-1Sn-1Pb-37Zn	21-260	21.6
	Manganese bronze		
	60 ksi	21-204	20.5
25	65 ksi	21-93	21.6
	110 ksi	21-260	19.8
	Aluminum bronze		
30	Alloy 9A	17
	Alloy 9B	20-250	17
	Alloys 9C, 9D	16.2
35	Iron and iron alloys		
	Pure iron	20	11.7
	Fe-C alloys		
40	0.06% C	20-100	11.7
	0.22% C	20-100	11.7
	0.40% C	20-100	11.3
45	0.56% C	20-100	11.0
	1.08% C	20-100	10.8
	1.45% C	20-100	10.1
	Invar (36% Ni)	20	0.2
50	13Mn-1.2C	20	18.0
	13Cr-0.35C	20-100	10.0

	<u>Metal or alloy</u>	<u>Temperature</u> °C	<u>Coefficient of expansion</u> <u>μ in./in. °C</u>
5	12.3Cr-0.4Ni-0.09C	20-100	9.8
	17.7Cr-9.6Ni-0.06C	20-100	16.5
	18W-4Cr-1V	0-100	11.2
10	Gray cast iron	0-100	10.5
	Malleable iron (pearlitic)	20-400	12
	Lead and lead alloys		
	Corroding lead		
15	(99.73 + % Pb)	17-100	29.3
	5-95 solder	15-110	28.7
	20-80 solder	15-110	26.5
	50-50 solder	15-110	23.4
20	1% antimonial lead	20-100	28.8
	Hard lead (94Pb-4Sb)	20-100	27.8
	Hard lead (94Pb-6Sb)	20-100	27.2
	8% antimonial lead	20-100	26.7
25	9% antimonial lead	20-100	26.4
	Lead-base babbitt SAE 14	20-100	19.6
	Alloy 8	20-100	24.0
30	Magnesium and magnesium alloys		
	Magnesium (99.8%)	20	25.2
35	Casting alloys		
	AM100A	18-100	25.2
40	AZ63A	20-100	26.1
	AZ91A, B, C	20-100	26
	AZ92A	18-100	25.2
45	HZ32A	20-200	26.7
	ZH42	20-200	27
	ZH62A	20-200	27.1
	ZK51A	20	26.1
50	EZ33A	20-100	26.1
	EK30A, EK41A	20-100	26.1

	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of expansion μ in./in. °C</u>
5	Wrought alloys		
	M1A, A3A	20-100	26
	AZ31B, PE	20-100	26
	AZ61A, AZ80A	20-100	26
10	ZK60A, B	20-100	26
	HM31A	20-93	26.1
15	Nickel and nickel alloys		
	Nickel (99.95% Ni + Co)	0-100	13.3
	Duranickel	0-100	13.0
20	Monel	0-100	14.0
	Monel (cast)	25-100	12.9
	Inconel	20-100	11.5
	Ni-o-nel	27-93	12.9
25	Nickel and nickel alloys		
30	Hastelloy B	0-100	10.0
	Hastelloy C	0-100	11.3
	Hastelloy D	0-100	11.0
	Hastelloy F	20-100	14.2
35	Hastelloy N	21-204	10.4
	Hastelloy W	23-100	11.3
	Hastelloy X	26-100	13.8
	Illium G	0-100	12.19
40	Illium R	0-100	12.02
	80Ni-20Cr	20-1000	17.3
	60Ni-24Fe-16Cr	20-1000	17.0
	35Ni-45Fe-20Cr	20-500	15.8
45	Constantan	20-1000	18.8

Tin and tin alloys

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	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of Expansion μin./in °C</u>
5	Pure tin	0-100	23
	Solder (70Sn-30Pb)	15-110	21.6
	Solder (63Sn-37Pb)	15-110	24.7
10	Titanium and titanium alloys		
	99.9% Ti	20	8.41
	99.0% Ti	93	8.55
15	Ti-5Al-2.5Sn	93	9.36
	Ti-8Mn	93	8.64
20	Zinc and zinc alloys		
	Pure zinc	20-250	39.7
	AG40A alloy	20-100	27.4
25	AC41A alloy	20-100	27.4
	Commercial rolled zinc		
	0.08 Pb	20-40	32.5
	0.3 Pb, 0.3 Cd	20-98	33.9(a)
30	Rolled zinc alloy		
	(1 Cu. 0.010 Mg)	20-100	34.8(b)
	Zn-Cu-Ti alloy		
35	(0.8 Cu.0.15 Ti)	20-100	24.9(c)
	Pure metals		
40	Beryllium	25-100	11.6
	Cadmium	20	29.8
	Calcium	0-400	22.3
	Chromium	20	6.2
45	Cobalt	20	13.8
	Gold	20	14.2

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Pure metals

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	<u>Metal or alloy</u>	<u>Temperature °C</u>	<u>Coefficient of expansion μin./in. °C</u>
5	Iridium	20	6.8
	Lithium	20	56
	Manganese	0-100	22
	Palladium	20	11.76
10	Platinum	20	8.9
	Rhenium	20-500	6.7
	Rhodium	20-100	8.3
	Ruthenium	20	9.1
15	Silicon	0-1400	5
	Silver	0-100	19.68
	Tungsten	27	4.6
20	Vanadium	23-100	8.3
	Zirconium	5.85

25 Certain of the metals, such as Aluminum, could be used as containers or container components for this invention. However, as will be explained, they are deemed most useful as wires or bands which surround a frangible container section (of frangible plastic or the like) which has a lower coefficient of linear expansion than the metal, so that, when the unit is subjected to cold water, the wire or band contracts by a sufficient amount to cause the relatively non-contractive section to fracture and release the conditioner.

30 Thus, generally speaking, plastics are the preferred materials for containers of this invention and, where used, metals for surrounding bands or wires.

Indeed, containers of this invention wherein a wire surrounds a frangible section—work best when the plastic of the container is hard and brittle under all temperatures of the washing cycles, so that the contraction of the wire can more easily fracture the frangible section.

35 Reproduced below from "Structural Plastics Design Manual" published by the American Society of Civil Engineers is Table 1-1 which sets forth properties of certain thermoplastic and thermosetting materials:

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Table 1-1
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics (1.2)*

5

PROPERTY	ASTM
Material Type	Test
1. Specific Gravity	D792
2. Tensile Strength, psi	D638
3. Elongation, %	D638
4. Tensile Elastic Modulus, 10^6 psi	D638
5. Compressive Strength, psi	D695
6. Flexural Strength, psi	D790
7. Impact Strength, ft-lb/in, Izod	D256
8. Hardness, Rockwell	D785
9. Compressive Elastic Modulus, 10^6 psi	D695
10. Flexural Elastic Modulus, 10^6 psi	D790
11. Thermal Conductivity, Btu-in/hr-ft ² - °F	C177
12. Specific Heat, Btu/lbm - °F	-
13. Thermal Expansion, 10^{-6} in/in-°F	D696
14. Deflection Temperature, °F 264 psi	D648
64 psi	
15. Refractive Index	D542
16. Clarity	-
17. Water Absorption, 24hr, 1/8 in thick, %	D570
18. Effect of Sunlight	-
19. Methods of Processing	-

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Table 1-1
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics (1.2)*

5	PROPERTY	Acrylics
	Material Type	PMMA
		Cast Sheet
	1. Specific Gravity	1.17-1.20
10	2. Tensile Strength, psi	8000-11000
	3. Elongation, %	2-7
	4. Tensile Elastic Modulus, 10^6 psi	0.35-0.45
15	5. Compressive Strength, psi	11000-19000
	6. Flexural Strength, psi	12000-17000
	7. Impact Strength, ft-lb/in, Izod	0.3-0.4
	8. Hardness, Rockwell	M80-M100
20	9. Compressive Elastic Modulus, 10^6 psi	0.39-0.48
	10. Flexural Elastic Modulus, 10^6 psi	0.39-0.48-
	11. Thermal Conductivity, Btu-in/hr-ft ² - °F	1.16-1.74
	12. Specific Heat, Btu/lbm - °F	0.35
25	13. Thermal Expansion, 10^{-6} in/in-°F	27.8-50.0
	14. Deflection Temperature, °F 264 psi	160-215
	64 psi	165-235
30	15. Refractive Index	1.48-1.50
	16. Clarity	Transparent
		to Opaque
	17. Water Absorption, 24hr, 1/8 in thick, %	0.2-0.4
35	18. Effect of Sunlight	None
	19. Methods of Processing	Injection mold
		Extrusion
		Cast
40		Thermoform
		using cast or
		extruding sheet
45		
50		
55		

Table 1-1
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics (1.2)*

5		THERMOPLASTICS
	PROPERTY	Polyacetal
	Material Type	Homopolymer
	1. Specific Gravity	1.42
10	2. Tensile Strength, psi	10000
	3. Elongation, %	25-75
	4. Tensile Elastic Modulus, 10^6 psi	0.52
15	5. Compressive Strength, psi	18000(10% defl.)
	6. Flexural Strength, psi	14100
	7. Impact Strength, ft-lb/in, Izod	1.4 (Inj.)
		2.3 (Ext)
20	8. Hardness, Rockwell	M94, R210
	9. Compressive Elastic Modulus, 10^6 psi	0.67
	10. Flexural Elastic Modulus, 10^6 psi	0.41
	11. Thermal Conductivity, Btu-in/hr-ft ² - °F	1.60
25	12. Specific Heat, Btu/lbm - °F	0.35
	13. Thermal Expansion, 10^{-6} in/in-°F	55.6
	14. Deflection Temperature, °F 264 psi	255
	64 psi	338
30	15. Refractive Index	1.48
	16. Clarity	Translucent
		to Opaque
35	17. Water Absorption, 24hr, 1/8 in thick, %	0.25
	18. Effect of Sunlight	Chalks Slightly
	19. Methods of Processing	Injection mold
		Extrusion
40		Blow mold

Table 1-1
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics (1.2)*

PROPERTY		Polyvinyl Chloride
Material Type		PVC
		Rigid
1. Specific Gravity		1.30-1.58
2. Tensile Strength, psi		6000-7500
3. Elongation, %		40-80
4. Tensile Elastic Modulus, 10^6 psi		0.35-0.60
5. Compressive Strength, psi		8000-13000
6. Flexural Strength, psi		10000-16000
7. Impact Strength, ft-lb/in, Izod		0.4-20.0
8. Hardness, Rockwell		D65-D85 (Shore)
9. Compressive Elastic Modulus, 10^6 psi		-
10. Flexural Elastic Modulus, 10^6 psi		0.30-0.50
11. Thermal Conductivity, Btu-in/hr-ft ² - °F		1.02-1.45
12. Specific Heat, Btu/lbm - °F		0.25-0.35
13. Thermal Expansion, 10^{-6} in/in-°F		27.8-55.6
14. Deflection Temperature, °F 264 psi		140-170
	64 psi	135-180
15. Refractive Index		1.52-1.55
16. Clarity		Translucent to Opaque
17. Water Absorption, 24hr, 1/8 in thick, %		0.04-0.40
18. Effect of Sunlight		Varies with formula- tion
19. Methods of Processing		Injection mold Extrusion Blow mold Calendering for rigid and flexible sheet

Note: 1psi = 6.896 kPa; 1 in = 25.4 mm; 1 ft = 0.305 m; 1 Btu-in/hr-ft²-°F = 0.144 W/m²·°F; 1 ft² = 0.09 m²; 1 Btu/lbm - °F = 4184.0 J/kg - °K; 1 ft-lb/in = 34.4 J/mm; °F = 1.8°C + 32

Table 1-1 (Continued)
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics

5

THERMOPLASTICS

10	Acrylonitrile- Butadiene-Styrene	Polyethylene	Polypropylene	
	ABS	PE	PP	
	High Impact	High Density		
15		HDPE	Unmodified	
	1.01-1.04	0.94-0.97	0.90-0.91	1.
	4800-6300	3100-5500	4300-5500	2.
	5-70	20-1300	200-700	3.
20	0.23-0.33	0.06-0.18	0.16-0.23	4.
	4500-8000	2700-3600	5500-8000	5.
	8000-11000	-	6000-8000	6.
25	6.5-7.5	0.5-20.0	0.5-2.2	7.
	R85-R105	D60-D70	R80-R110	8.
		(Shore)		
	0.14-0.30	-	0.15-0.30	9.
30	0.25-0.35	0.10-0.26	0.17-0.25	10.
	-	3.19-3.60	0.81	11.
	-	0.55	0.46	12.
	52.8-61.1	61.1-72.2	32.2-56.7	13.
35	205-215	110-130	125-140	14.
	210-225	140-190	200-250	
	-	1.54	1.49	15.
40	Translucent	-	Transparent	16.
	to Opaque		to Opaque	
	0.20-0.45	0.01	0.01-0.03	17.
	None to Sun-	Crazes if	Crazes if	18.
45	light Yellowing	Unprotected	Unprotected	
50	Injection mold	Injection mold	Injection mold	19.
	Extrusion	Extrusion	Extrusion	
	Thermoforming	Blow mold	Blow mold	
55		Rotational mold	Rotational mold	

Table 1-1 (Continued)
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics

THERMOPLASTICS

10	Polycarbonate	Nylon	
	PC	PA	
	Unfilled	Type 6/6	
		Unmodified	
15	1.20	1.13-1.15	1.
	8000-9500	12000	2.
	100-130	60	3.
	0.30-0.35	-	4.
20	12500	15000(Yield)	5.
	13500	17000	6.
	12.0-18.0	1.0	7.
	M70-M78	R120	8.
25	R115-R125	M83	
	0.35	-	9.
	0.32-0.35	0.42	10.
30	1.33	1.68	11.
	0.28-0.30	0.40	12.
	36.7	44.4	13.
	265-285	167	14.
35	270-290	374	
	1.59	1.53	15.
	Transparent	Translucent	16.
	to Opaque	to Opaque	
40	0.15-0.18	1.5	17.
	Slight Discoloration and Embrittlement	Embrittlement	18.
45	Injection mold	Injection mold	19.
	Extrusion	Extrusion	
50	Thermoforming	Blow mold	
	Rotational mold	Rotational mold	
55		Casting	

Table 1-1 (Continued)
 Structural and Physical Properties and Processing Methods
 for Representative Engineering Plastics
 THERMOPLASTICS

PROPERTY	ASTM Test	Fluoroplastic PTFE	Styrene- Acrylonitrile SAN	Phenylene Oxide PPO Non- Reinforced
Material Type			Unfilled	
1. Specific Gravity	D792	2.14-2.20	1.08-1.10	1.06-1.10
2. Tensile Strength psi	D638	2000-5000	9000-12000	7800-11500
3. Elongation, %	D638	200-400	1.5-3.7	50-60
4. Tensile Elastic Modulus, 10 ⁶ psi	D638	0.2	0.40-0.56	0.36-0.38
5. Compressive Strength, psi	D695	1700	14000-17000	16000-16400
6. Flexural Strength, psi	D790	-	14000-19000	12800-13500
7. Impact Strength ft-lb/in, Izod	D256	3.0	0.35-0.50	5.0
8. Hardness, Rockwell	D785	D50-D55 (Shore	M80-M90	R113-R119
9. Compressive Elastic Modulus, 10 ⁶ psi	D695	-	0.53	0.37
10. Flexural Elastic Modulus, 10 ⁶ psi	D790	-	to 0.55	0.36-0.40
11. Thermal Conductivity Btu-in/hr-ft ² -°F	C177	1.74	0.84	1.50
12. Specific Heat, Btu.lbm-°F	-	0.25	0.32-0.34	0.32
13. Thermal Expansion,				

Table 1-1 (Continued)
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics

PROPERTY	ASTM Test	Fluoroplastic PTFE	THERMOSPLASTICS	
			Styrene Acrylonitrile SAN Unfilled	Phenylene Oxide PPO Non- Reinforced
Material Type				
10 ⁻⁶ in/in-°F	D696	55.6	20.0-21.1	28.9
14. Deflection				
Temperature,				
°F 264 psi/	D648	-	190-220	212-265
64 psi		250	-	190-280
15. Refractive Index	D542	1.35	1.56-1.57	-
16. Clarity	-	Opaque	Transparent	Opaque
17. Water Absorption				
24 hr, 1/8 in				
thick, %	D570	0.00	0.20-0.30	0.07
18. Effect of				
Sunlight	-	None	Slight Yellowing	Colours Fade
19. Methods of				
Processing	-	See text	Compression	Injection
		Injection	mold	mold
		mold	Extrusion	
		Extrusion		
		Injection-		
		blow mold		

Note: 1 psi = 6.896kPa; 1 in = 25.4 mm; 1 ft = 0.305 m;
 1 Btu-in/hr-ft²-°F = 0.144 W/m² - °K; 1 Ft² = 0.09m²;
 1 Btu/lbm - °F = 4184.0 J/kg - °K; 1 ft-lb/in = 34.4 J/mm;
 °F = 1.8°C + 32

Table 1-1 (Continued)
Structural and Physical Properties and Processing Methods
for Representative Plastics

5

THERMOSETS

10

15

20

25

30

35

40

45

50

55

Polyester**Epoxy****Phenol-
Formaldehyde
PF****EP****Cast
Rigid****Cast****Wood Flour
and Cotton
Flock Filled**

1.10-1.46

1.11-1.40

1.

1.34-1.45

6000-13000

4000-13000

2.

5000-9000

5

3-6

3.

0.4-0.8

0.30-0.64

0.35

4.

0.80-1.70

13000-30000

15000-25000

5.

22000-36000

8500-23000

13300-21000

6.

7000-14000

0.20-0.40

0.2-1.0

7.

0.24-0.60

M70-M115

M80-M110

8.

M100-M115

-

-

9.

-

-

-

10.

1.00-1.20

1.16

1.16-1.45

11.

1.16-2.38

-

0.25

12.

0.32-0.40

30.6-55.5

25.0-36.1

13.

16.7-25.0

140-400

115-550

14.

300-370

-

-

-

-

1.52-1.57

1.55-1.61

15.

-

**Transparent
to Opaque****Transparent**

16.

-

0.15-0.60

0.08-0.15

17.

0.30-1.20

**Slight
Yellowing****None**

18.

-

**Compression mold
Injection mold
See reinforced
plastics****Compression mold 19.
Injection mold
See reinforced
plastics****Compression mold
Transfer mold
Injection mold
Saturated sheet
laminates**

Table 1-1 (Continued)
Structural and Physical Properties and Processing Methods
for Representative Engineering Plastics

THERMOSETS			
	Melamine Formaldehyde MF	Silicone SI	
	Alpha Cellulose Filled	Glass Fiber Filled Molding Compound	
	1.47-1.52	1.80-1.90	1.
	7000-13000	4000-6500	2.
	0.6-0.9	-	3.
	1.20-1.40	-	4.
	40000-45000	10000-15000	5.
	10000-16000	10000-14000	6.
	0.24-0.35	0.3-8.0	7.
	M155-M125	M80-M90	8.
	-	-	9.
	0.11	1.0-2.5	10.
	2.03-2.90	2.03-2.61	11.
	0.40	0.19-0.22	12.
	22.2	11.1-27.8	13.
	350-370	900	
	-	-	14.
	-	-	15.
	Translucent	Opaque	16.
	0.10-0.60	0.2	17.
	Pastels Yellow	None	18.
	Compression mold Transfer mold Injection mold Saturated sheet laminates	Compression mould.	19.

Figure 1 shows a first embodiment of container of this invention. As shown the Container 20 is in the shape of a bottle, although many other shapes can be employed.

Container 20 has an upper portion 21 and a lower portion 22 and a groove 23 extending around the container at the junction of portions 21 and 22. A wire or band 24 tightly encircles groove 23. (Hereinafter, when "wire" is used, the term is meant to include a band as well or as an alternative.)

Wire 24 is made of a thermoresponsive material, which, in one embodiment of this invention, has a higher coefficient of linear expansion than does the material which forms groove 23, which material may be--and undoubtedly should be for ease of commercial production--the same as parts 21 and 22. The material of groove 23, as well as components 21 and 22 can be of any suitable thermosetting or thermoplastic plastic(s) such as those listed in Table I-I above. Polyethylene (PE) or polypropylene (PP) are very good choices for this purpose.

Thus, when the container 20 is placed in the washing machine at the beginning of the washing process and the wash temperature is set at warm (approximately 110-140 degrees F or 43.4-60 degrees C) or hot (approximately 140-170 degrees F or 60-76.6 degrees C), both wire 24 and material 23 expand. More specifically, wire 24 expands to a greater degree than does material 23.

However, when the cold rinse water enters the washing machine--at a temperature usually in the range of about 40-60 degrees F (4.4-15.55 degrees C)--material 23 contracts only slightly, whereas wire 24, with its high coefficient of linear expansion, contracts to a significantly greater degree, so much so that the constricting force of wire 24 ruptures container 20 at groove 23. (It is preferred that the material of container 20 be made as thin as possible at the area of groove 23 so that it is more easily fractured.) Groove 23, in any event, may be termed the "frangible section".

When the rupture occurs, top 21 breaks away from the bottom 22, as indicated by rupture lines 26-29. Wire 24 simply detaches. What happens then is that conditioner 30, which was encased within Container 20, is permitted to flow from part 22 as shown in Figure 2 (and from part 21 if the Container is filled above the groove 23). In turn, the conditioner flows into the cold rinse water and completely impregnates the clothes, which by this time are substantially free of detergent. Consequently, there is no adverse reaction between the detergent and conditioner, and the clothes are conditioned in a most desirable way. That is, they are soft and do not have static cling (when anti-static agents are employed.)

Figures 3 and 4 illustrate another embodiment of the invention. In this case, a container 40 has a bottom component 42 and may be cylindrical. Component 42 has external threads 43 around its necked-in upper portion which thread engage matching threads of an upper portion 41. It will be understood the container 42 is filled with conditioner.

A band or wire 44 surrounds the upper part of top component 41. As in the case of container 20, the band or wire 44 has a very high coefficient of linear expansion relative to the coefficient of linear expansion of the material(s)--preferably plastic--of which component 41 is made, so that, as in the case of container 20, when the water is switched from warm to cold in the rinse cycle, wire or band 44 contracts so much that it fractures the part of component 41 which it surrounds.

After such fracturing, as shown in figure 4, the upper end of component 41 detaches from its lower end, thereby permitting the escape of the conditioner 49 into the rinse water to condition the clothes. It will be noted that wire or band 44 detaches. Moreover, as shown in Figure 4, a preferable structure involves the formation of a groove for wire or band 44 as indicated at 45-48.

The wires or bands 24, 44 may be of any suitable metal or plastic having a very high coefficient of linear expansion relative to the containers which they surround. These types function because of the difference in such coefficient between them and the containers which they surround.

However, wires 24, 44 may alternatively be constructed from so-called "memory metals" or "memory" plastics.

Memory metals are thermo-responsive and are generally classified as intermetallic alloy compounds and are generally described in U. S. Patent 3,174,851. The best known such alloys are of nickel-titanium, particularly that group commonly known as NITINOL [not a trademark], which are near stoichiometric NiTi alloys. As described in U. S. Patents 4,472,939 and 3,913,326, NITINOL has "memory", i.e., when heated above the transition temperature of the particular alloy (which temperature differs widely depending upon the other constituents of the alloy), the alloy "remembers" the shape it was in when so heated (its "hot" shape) and, when cooled below such temperature, it can be deformed into another shape (the "deformed" or "cold" shape). Thus, when such an alloy has been so processed and is, for example, cooled below such temperature, it assumes the deformed shape, but when heated above that temperature, it reverts to its "hot" shape.

Using this property, NITINOL can be used, for example, as wires or bands 24, 44 in which case the

NITINOL is processed to assume an enlarged "hot" shape above a transition temperature of about 60 degrees F (15.5 degrees C) and to contract to a much smaller shape below such temperature in order to break containers 20 and 40.

Alternatively, the NITINOL may be caused to be bent into "hot" form and rendered to be straight when cooled below the approximate 60 degrees F. See U. S. Patent 4,472,939.

Thus wires 24, 44 can be memory-type thermoresponsive materials such as NITINOL. In the case of wire 24, for example, it is formed into a circle below the 60 degree F (15.5 degrees C) transition temperature to a size substantially smaller than groove 23 (the "initial" size). It is then heated above such transition temperature and formed to a size which fits snugly around groove 23. Then, when wire 24 is cooled below such temperature in the rinse water of the washing machine, it reverts to its deformed or "cold" shape which is much smaller than groove 23 and consequently groove 23 is fractured to release the conditioners 30 as shown in Figure 2.

The foregoing memory metals can also be used in connection with the wires or bands of Figures 3 and 4.

Another type of thermally responsive "memory" element or material useful for wires 24, 44 are the plastics described in U.S. Patent 4,637,944 which involves cross-linkable polymeric materials such as polyethylene (PE), PE copolymers, PVC, elastomers, blends of elastomers and PVC, EVA and EVA/wax blends.

Such plastic memory materials are cross-linked by irradiation or other suitable means, heated above their transition temperature and formed into a first or "hot" shape and then cooled to lock or fix the hot shape. When cooled below such temperature—which would be about 60 degrees F (15.55 degrees C) for present purposes—the material can be deformed into a "cold" shape. When subsequently heated above that transition temperature, the material reverts to the hot shape.

Thus, wires or bands 24, 44 can also be made of memory plastics. By selecting wires 24, 44 of a size substantially smaller than the grooves in Figures 1-4 when they are at a temperature below a transition temperature of about 60 degrees F (15.55 degrees C) and then heating them above such transition temperature and forming them into a size to fit around groove 23 as the hot shape, the wires will contract to their cold shape when they enter the rinse water and break open Containers 20 and 40.

As set forth in U. S. Patent 3,403,238 TiNi undergoes a martensitic (diffusionless) transition with the ability of the alloy to undergo such a transition being temperature dependent. The maximum temperature at which this transition can occur is called the critical temperature and this temperature is a function of the alloy composition. Some alloy compositions and their approximate critical temperature given in such patent are:

Alloy composition wt. % nickel	Critical temperature C
53.5	98
55	140
55.5	30
56	-25

Since it is desired that the NiTi alloy used in this invention have a critical (transition) temperature of just above 60 degrees F (15.55 degrees C), the weight percent of nickel will be more than 55.5 and less than 56.

U. S. Patent 3,558,369 discloses other memory metal alloys that can be designed to undergo shape changes from -273 C to about 727 degrees C including $\text{TiNi}_x\text{Co}_{1-x}$, $\text{TiCo}_x\text{Fe}_{1-x}$, $\text{ZrRh}_x\text{Ru}_{1-x}$ and $\text{ZrPd}_x\text{Rh}_{1-x}$. This patent notes that "a wire can be made so that it is curled, the temperature can be lowered below its critical (transition) temperature, the wire can be straightened out and then heated to the critical temperature whereupon the original curled configuration is returned to the wire." These alloys, which are also included in the term memory metals herein, exhibit a transition range from 166 degrees C to below 0 degrees C for Ni rich combinations. Accordingly, it is clear that, by adjusting the amounts of the various components in these memory metal alloys, it is possible to select one or more combinations which have a critical temperature of about 15 degrees C, as desired for this invention.

It may be desirable to produce this invention in the form of a sphere and this embodiment is shown in Figures 5-7.

Thus, the sphere is generally shown as 50 and preferably is composed of a component, which may be a hemisphere 51, having a relatively low coefficient of linear expansion and a second component, 54 having a relatively high coefficient of linear expansion.

Components 51, 54 are held together by frictional fit under room temperature by means of an inwardly projecting element 52 at the end of component 51 engaging an element 56 formed at the end of component 54.

When the container 50 encounters the cold rinse water, inner component 54 contracts so much that element 56 retracts from engagement from element 52, so that the components parts 51 and 54 detach from each other and the conditioner 59 is free to emerge from the two shells 51, 54 as shown in Figure 7 and enter the rinse water to impregnate the clothing.

Figures 8 and 9 show yet another embodiment of this invention wherein there is an inner component 62 which is connected to an outer component 61 by frictional engagement at room temperature at 63 where their respective ends overlap. Again, component 62 has a much higher coefficient of linear expansion than 61 so that, when the cold rinse water is introduced, component 62 contracts more than component 61 and the components detach, releasing conditioner 64 to the rinse water to condition the clothing. This embodiment may well be highly suitable for commercial manufacture since it may be made of two inexpensive plastics and has no complicated parts.

Figure 10 illustrates another form of the invention wherein the container 80 comprises upper and lower portions 81 and 82 whose ends adjoin at 83. The portions 81 and 82 are held together by a plastic band 84 which is tightly wrapped around the joint 83. However, band 84 is made of plastic which weakens or decomposes when it encounters cold water. When that happens, components 81 and 82 separate, releasing conditioner 85 into the rinse water.

Set forth below is a detailed description of fabric conditioners and optional additives or components, all of which are collectively embraced by the terms conditioner(s) in the specification and claims hereof.

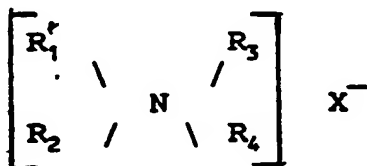
FABRIC CONDITIONING COMPOSITION

For purposes of the present invention a "fabric conditioning agent" is any substance which improves or modifies the chemical or physical characteristics of the fabric being treated therewith. Examples of suitable fabric conditioning agents include perfumes, elasticity improving agents, flame proofing agents, pleating agents, antistatic agents, softening agents, soil proofing agents, water repellent agents, crease proofing agents, acid repellent agents, antishrinking agents, heat proofing agents, coloring material, brighteners, bleaching agents, fluorescers and ironing aids. These agents can be used alone or in combination.

The most preferred fabric conditioning composition for use in the present invention contains antistatic and softener agents. Such agents provide benefits sought by many consumers and the convenience offered by the present invention would serve them well.

The fabric softener/antistat composition employed herein can contain any of the wide variety of nonionic and cationic materials known to supply these benefits. These materials are substantive, and have a melting point within the range from about 20° C to about 115° C, preferably within the range of from about 30° C to about 60° C.

The most common type of cationic softener/antistat materials are the cationic nitrogen-containing compounds such as quaternary ammonium compounds and amines having one or two straight-chain organic groups of at least eight carbon atoms. Preferably, they have one or two such groups of from 12 to 22 carbon atoms. Preferred cation-active softener compounds include the quaternary ammonium softener/antistat compounds corresponding to the formula



wherein R₁ is hydrogen or an aliphatic group of from 1 to 22 carbon atoms; R₂ is an aliphatic group having from 12 to 22 carbon atoms; R₃ and R₄ are each alkyl groups of from 1 to 3 carbon atoms; and X is an

anion selected from halogen, acetate, phosphate, nitrate and methyl sulfate radicals.

Because of their excellent softening efficacy and ready availability, preferred cationic softener/antistat compounds of the invention are the dialkyl dimethyl ammonium chlorides, wherein the alkyl groups have from 12 to 22 carbon atoms and are derived from long-chain fatty acids, such as hydrogenated tallow. As employed herein, alkyl is intended as including unsaturated compounds such as are present in alkyl groups derived from naturally occurring fatty oils. The term "tallow" refers to fatty alkyl groups derived from tallow fatty acids. Such fatty acids give rise to quaternary softener compounds wherein R₁ and R₂ have predominantly from 16 to 18 carbon atoms. The term "coconut" refers to fatty acid groups from coconut oil fatty acids. The coconut-alkyl R₁ and R₂ groups have from about 8 to about 18 carbon atoms and predominate in C₁₂ to C₁₄ alkyl groups. Representative examples of quaternary softeners of the invention include tallow trimethyl ammonium chloride; ditallow dimethyl ammonium chloride; ditallow dimethyl ammonium methyl sulfate; dihexadecyl dimethyl ammonium chloride; di(hydrogenated tallow) dimethyl ammonium chloride; dioctadecyl dimethyl ammonium chloride; dieicosyl dimethyl ammonium chloride; didocosyl dimethyl ammonium chloride; di(hydrogenated tallow) dimethyl ammonium methyl sulfate; dihexadecyl diethyl ammonium chloride, dihexadecyl dimethyl ammonium acetate; ditallow dipropyl ammonium phosphate; ditallow dimethyl ammonium nitrate; di(coconut-alkyl) dimethyl ammonium chloride.

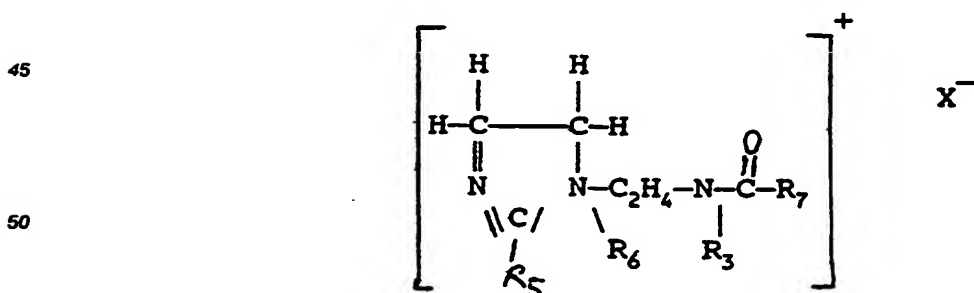
An especially preferred class of quaternary ammonium softener/antistats of the invention correspond to the formula



wherein R₁ and R₂ are each straight chain aliphatic groups of from 12 to 22 carbon atoms and X is halogen, 30 e.g. chloride or methyl sulfate. Especially preferred are ditallow dimethyl ammonium methyl sulfate (or chloride) and di(hydrogenated tallow-alkyl) dimethyl ammonium methyl sulfate (or chloride) and di(coconut-alkyl) dimethyl ammonium methyl sulfate (or chloride), these compounds being preferred from the standpoint of excellent softening properties and ready availability.

Suitable cation-active amine softener/antistat compounds are the primary, secondary and tertiary amine compounds having at least one straight-chain organic group of from 12 to 22 carbon atoms and 1,3-propylene diamine compounds having a straight-chain organic group of from 12 to 22 carbon atoms. Examples of such softener actives include primary tallow amine; primary hydrogenated-tallow amine; tallow 1,3-propylene diamine; oleyl 1,3-propylene diamine; coconut 1,3-propylene diamine; soya 1,3-propylene diamine and the like.

40 Other suitable cation-active softener/antistat compounds herein are the quaternary imidazolinium salts. Preferred salts are those conforming to the formula



55 wherein R₆ is an alkyl containing from 1 to 4, preferably from 1 to 2 carbon atoms, R₃ is an alkyl containing from 1 to 4 carbon atoms or a hydrogen radical, R₂ is an alkyl containing from 1 to 22, preferably at least 15 carbon atoms or a hydrogen radical, R₇ is an alkyl containing from 8 to 22, preferably at least 15 carbon atoms, and X is an anion, preferably methylsulfate or chloride ions. Other suitable anions include those

disclosed with reference to the cationic quaternary ammonium fabric softener/antistats described herein-before. Particularly preferred are those imidazolinium compounds in which both R_7 and R_8 are alkyls of from 12 to 22 carbon atoms, e.g. 1-methyl-1-[(stearoylamide)ethyl]-2-heptadecyl-4,5-dihydroimidazolinium methyl sulfate; 1-methyl-1-[(palmitoylamide)ethyl]-2-octadecyl-4,5-dihydroimidazolinium chloride and 1-methyl-1-[(tallowamide)ethyl]-2-tallow-imidazolinium methyl sulfate.

Other cationic quaternary ammonium fabric softener/antistats which are useful herein include, for example, alkyl (C_{12} to C_{22})-pyridinium chlorides, alkyl (C_{12} to C_{22})-alkyl (C_1 to C_3)-morpholinium chlorides and quaternary derivatives of amino acids and amino esters.

Nonionic fabric softener/antistat materials include a wide variety of materials including sorbitan esters, fatty alcohols and their derivatives, diamine compounds and the like. One preferred type of nonionic fabric antistat/softener material comprises the esterified cyclic dehydration products of sorbitol, i.e. sorbitan ester. Sorbitol, itself prepared by catalytic hydrogenation of glucose, can be dehydrated in well-known fashion to form mixtures of cyclic 1.4 and 1.5 sorbitol anhydrides and small amounts of isosorbides. (See Brown; U.S. Pat. No. 2,322,821; issued June 29, 1943). The resulting complex mixtures of cyclic anhydrides of sorbitol are collectively referred to herein as "sorbitan". It will be recognized that this "sorbitan" mixture will also contain some free uncyclized sorbitol.

Sorbitan ester fabric softener/antistat materials useful herein are prepared by esterifying the "sorbitan" mixture with a fatty acyl group of standard fashion, e.g. by reaction with a fatty (C_{10} - C_{24}) acid or fatty acid halide. The esterification reaction can occur at any of the available hydroxyl groups, and various mono-, di-, etc., esters can be prepared. In fact, complex mixtures of mono-, di-, tri-, and tetra-esters almost always result from such reactions, and the stoichiometric ratios of the reactants can simply be adjusted to favor the desired reaction product.

The foregoing complex mixtures of esterified cyclic dehydration products are sorbitan (and small amounts of esterified sorbitol) are collectively referred to herein as "sorbitan esters". Sorbitan mono- and di-esters of lauric, myristic, palmitic, stearic and behenic acids are particularly useful herein for conditioning the fabrics being treated. Mixed sorbitan esters, e.g. mixtures of the foregoing esters, and mixtures prepared by esterifying sorbitan with fatty acid mixtures such as the mixed tallow and hydrogenated palm oil fatty acids, are useful herein and are economically attractive. Unsaturated C_{10} - C_{18} sorbitan esters, e.g. sorbitan mono-oleate, usually are present in such mixtures. It is to be recognized that all sorbitan esters, and mixtures thereof, which are essentially water-insoluble and which have fatty hydrocarbyl "tails", are useful fabric softener/antistat materials in the context of the present invention.

The preferred alkyl sorbitan ester fabric softener/antistat materials herein comprise sorbitan mono-olaurate, sorbitan monomyristate, sorbitan monopalmitate, sorbitan monostearate, sorbitan monobehenate, sorbitan dilaurate, sorbitan dimyristate, sorbitan dipalmitate, sorbitan distearate, sorbitan dibehenate, and mixtures thereof, the mixed coconutalkyl sorbitan mono- and di-esters and the mixed tallowalkyl sorbitan mono- and di-esters. The tri- and tetra-esters of sorbitan with lauric, myristic, palmitic, stearic and behenic acids, and mixtures thereof, are also useful herein.

Another useful type of nonionic fabric softener/antistat material encompasses the substantially water-insoluble compounds chemically classified as fatty alcohols. Mono-ols, di-ols, and poly-ols having the requisite melting points and water-insolubility properties set forth above are useful herein. Such alcohol-type fabric conditioning materials also include the mono- and di-fatty glycerides which contain at least one "free" OH group.

All manner of water-insoluble, high melting alcohols (including mono- and di-glycerides), are useful herein inasmuch as all such materials are fabric sustantive. Of course, it is desirable to use those materials which are colorless, so as not to alter the color of the fabrics being treated. Toxicologically acceptable materials which are safe for use in contact with skin should be chosen.

A preferred type of unesterified alcohol useful herein includes the higher melting members of the so-called fatty alcohol class. Although once limited to alcohols obtained from natural fats and oils, the term "fatty alcohols" has come to mean those alcohols which correspond to the alcohols obtained from fats and oils, and all such alcohols can be made by synthetic processes. Fatty alcohols prepared by the mild oxidation of petroleum products are useful herein.

Another type of material which can be classified as an alcohol and which can be employed as the fabric softener/antistat material in the instant invention encompasses various esters of polyhydric alcohols. Such "ester-alcohol" materials which have a melting point within the range recited herein and which are substantially water-insoluble can be employed herein when they contain at least one free hydroxyl group, i.e., when they can be classified chemically as alcohols.

The alcoholic di-esters of glycerol useful herein include both the 1,3-di-glycerides and the 1,2-di-glycerides. In particular, di-glycerides containing two C_8 - C_{20} preferably C_{10} - C_{18} alkyl groups in the

molecule are useful fabric conditioning agents.

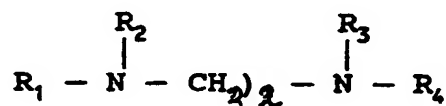
Non-limiting examples of ester-alcohols useful herein include: glycerol-1,2-dilaurate; glycerol-1,3-dilaurate; glycerol-1,2-dimyristate; glycerol-1,3-dimyristate; glycerol-1,2-dipalmitate; glycerol-1,3-dipalmitate; glycerol-1,2-distearate and glycerol-1,3-distearate. Mixed glycerides available from mixed tallowalkyl fatty acids, i.e. 1,2-ditallowalkyl glycerol and 1,3-ditallowalkyl glycerol are economically attractive for use herein. The foregoing ester-alcohols are preferred for use herein due to their ready availability from natural fats and oils.

Mono- and di-ether alcohols, especially the C₁₀-C₁₈ di-ether alcohols having at least one free -OH group, also fall within the definition of alcohols useful as fabric softener/antistat materials herein. The ether-alcohols can be prepared by the classic Williamson ether synthesis. As with the ester-alcohols, the reaction conditions are chosen such that at least one free, unetherified -OH group remains in the molecule.

Ether-alcohols useful herein include glycerol-1,2-dilauryl ether; glycerol-1,3-distearyl ether; and butane tetra-ol,1,2,3-trioctanyl ether.

Yet another type of nonionic fabric conditioning agent useful herein encompasses the substantially water-insoluble (or dispersible) diamine compounds and diamine derivatives. The diamine fabric conditioning agents are selected from the group consisting of particular alkylated or acylated diamine compounds.

Useful diamine compounds have the general formula



wherein R₁ is an alkyl or acyl group containing from about 12 to 20 carbon atoms; R₂ and R₃ are hydrogen or alkyl of from about 1 to 20 carbon atoms and R₄ is hydrogen C₁₋₂₀ alkyl or C₁₂₋₂₀ acyl. At least two of R₂, R₃ and R₄ are hydrogen or alkyl containing 1 to 3 carbon atoms, and n is from 2 to 6.

Non-limiting examples of such alkylated diamine compounds include:

C₁₅H₃₃-N(CH₃)-(CH₂)₃-N(CH₃)₂
 C₁₈H₃₇-N(CH₃)-(CH₂)₂-N(C₂H₅)₂
 C₁₂H₂₅-N(CH₃)-(CH₂)₃-HN-C₁₂H₂₅
 C₁₂H₂₅-N(C₂H₅)-(CH₂)₃-N(C₃H₇)₂
 R_{Tallow}NH-(CH₂)₃-N(C₂H₅)₂
 C₂₀H₄₁-N(CH₃)-(CH₂)₂-N(CH₃)₂
 C₁₃H₃₁-N(C₂H₅)-(CH₂)₃-NH₂
 C₁₈H₃₇-NH-(CH₂)₃-HN-CH₃
 C₁₆H₃₃-NH-(CH₂)₃-HN-C₁₆H₃₃
 R_{Tallow}N(CH₃)-(CH₂)₃-N(C₂H₅)₂
 C₁₆H₃₃N(CH₃)-(CH₂)₃-N(C₂H₅)₂
 C₁₂H₂₅N(C₂H₅)-(CH₂)₂-N(C₃H₇)₂ and
 C₁₄H₂₉N(CH₃)-(CH₂)₃-(CH₃)N-C₈H₁₇

wherein in the above formulas R_{Tallow} is the alkyl group derived from tallow fatty acid.

Other examples of suitable alkylated diamine compounds include N-tetradecyl, N-propyl-1,3-propanediamine, N-eicosyl, N,N',N'-triethyl-1,2-ethane-diamine and N-octadecyl, N,N',N'-tripropyl-1,3-propanediamine.

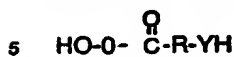
Examples of suitable acylated diamine fabric softener/antistat materials include C₁₃₋₂₀ amido amine derivatives.

The fabric softener/antistats mentioned above can be used singly or in combination in the practice of the present invention.

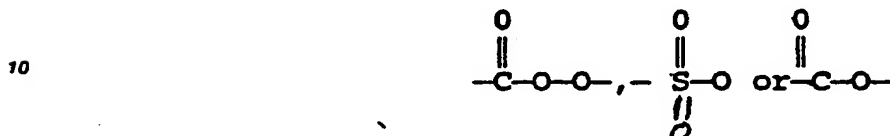
Preferred mixtures useful herein are mixtures of dialkyl dimethyl ammonium salts with imidazolinium salts and mixtures of these two materials with sorbitan esters. An especially preferred mixture includes ditallow dimethyl ammonium methyl sulfate and 1-methyl-1-(tallowamide)ethyl-2-tallow imidazolinium methyl sulfate in a ratio of from about 65:35 to about 35:65 and sorbitan tristearate in a ratio of from about 50:50 to about 5:95, sorbitan tristearate to the sum of the other two agents. Tallow alcohol or hydrogenated castor oil may be used to replace sorbitan tristearate in the above mixture with similar results being obtained. Another especially preferred mixture includes the above mixture wherein the sorbitan tristearate is absent and the other two components are present in a ratio of from about 65:35 to 35:65.

Another class of desirable fabric conditioning agents used in the articles herein are bleaches. These

include the common inorganic peroxy compounds such as alkali metal and ammonium perborates, percarbonates, monopersulfates and monoperphosphates. Solid organic peroxy acids, or the water-soluble, e.g. alkali metal, salts thereof of the general formula



wherein R is a substituted or unsubstituted alkylene or arylene group and Y is



15 or any other group which yields an anionic group in aqueous solution are also useful herein. These bleaches are more fully described in U.S. Pat. No. 3,749,673, July 31, 1973, Jones et al, incorporated herein by reference.

20 OPTIONAL COMPONENTS

In a preferred article herein the fabric conditioning composition is a softener/antistat composition in the form of a free flowing powder. To facilitate forming such a powder any of a wide variety of filler materials may be used in the present composition. Such fillers include inorganics such as sodium sulfate, calcium carbonate, aluminum oxide and smectite clays and organics such as high molecular weight polyethylene glycols. Smectite clays and aluminum oxide are preferred fillers herein since they may additionally help in insolubilizing the inner receptacle. A description of smectite clays may be found in U.S. Pat. No. 3,862,058, Jan 21, 1975, to Nirschl et al, incorporated herein by reference. The filler material may be present at a level ranging from about 5 % to 35% by weight of the softener/antistat composition. The fabric softening, antistat compositions herein can be also optionally contain minor proportions (i.e. 0.1% to about 15% by weight of various other ingredients which provide additional fabric conditioning benefits. Such optional ingredients include perfumes, fumigants, bactericides, fungicides, optical brighteners and the like. Specific examples of typical solid, water-soluble additives useful herein can be found in any current Year Book of the American Association of Textile Chemists and Colorists. Such additional components can be selected from those compounds which are known to be compatible with the softener/antistat agents employed herein, or can be coated with water-soluble coatings such as solid soaps, and the like, and thereby rendered compatible.

A preferred optional ingredient is a fabric substantive perfume material. Included among such perfume materials are musk ambrette, musk ketone, musk xylol, ethyl vanillin, musk tibertine, coumarina, aurantol and mixtures thereof. The above perfumes are preferably used in an amount of from about 0.1% to about 5% by weight of the fabric softener/antistat composition.

The water-soluble silicate materials recognized in the art as corrosion inhibitors can be employed in the present compositions at levels of about 5% by weight.

Release aids such as monionic surfactants can also be advantageously employed in the present invention.

It will be recognized that any of the foregoing types of optional components can be provided in a solid, particulate form which can be dispensed onto the fabrics concurrently with the fabric softener/antistat to provide the desired additional fabric treatment benefits.

Figure 11 illustrates another Container of this invention 90 having sidewalls 92,94, bottom 93 and a top 91. The Container, made preferably of frangible plastic, holds conditioners 89. Sidewall 94 has an inwardly extending portion 99 defining a lower shoulder 95. A memory metal or memory plastic 96 of one of the types described herein is held in position between shoulder 95 and lip 98 of top 91. A removable plug 100 seals the cavity in which element 96 is placed in order to protect element 96 during shipment and handling and also to insulate it from cold temperatures during shipping and storage. Plug 100 is removed just before using by the consumer.

As shown in Figure 12, when the container is immersed in water of 60 degrees F (15.55 degrees C) or less, the memory material 96, shown in its hot bent shape in Figure 11, reverts to its cold shape, which in this case is straight. The force of the element 96 straightening breaks portion 91a of top 91 and fractures

portion 99b of sidewall section 99, thereby rupturing the container and releasing conditioners 89 into the cold rinse water.

Figure 13 shows a top view of a wire or band 120 of memory plastic or metal of the type described in circular form which surrounds a container 121 (Figure 15) containing conditioners 122. Element 120 is processed so that it is circular above about 60 degrees F (15.55 degrees C) but contracts inwardly into a star shape 124 below that temperature as its cold shape as shown in Figure 14. Thus, when the container is immersed in water below the aforesaid temperature, element 124 contracts into the star shape and, as shown in Figure 16 fractures the container 121 so that conditioners 122 are released into the rinse water.

10

Claims

1. A container for clothes conditioner(s) and the like comprising at least one portion which detaches from the container when the container is in cold rinse water of a washing machine, whereby the conditioner is released from the container into the rinse water.

2. The invention of claim 1 wherein the container has a first portion and a second portion and said at least one of said portions has a groove therein, and where there is a wire or band surrounding the groove which contracts more than the material of the groove upon exposure to cold rinse water and fractures said groove and thereby causes the portions above and below the groove to separate, so that the conditioner is released into the cold water.

3. The invention of claim 2 wherein the top and bottom components are held together by threads.

4. The invention of claim 1 where the container comprises at least two components which are held together by frictional engagement at room temperature and wherein one component contracts so much more than the other component in cold rinse water that the components detach and release conditioner into the rinse water

5. The invention of claim 4 where the container comprises at least two hemispherical components.

6. A container for holding clothes conditioner and the like which comprises at least two components, wherein two of such components have open ends which are in contact with each other throughout the surfaces of the ends and wherein a band of material holds said contacting ends together, and wherein said band is made of a material which weakens when immersed in the cold rinse water of a washing machine during the cold rinse cycle of such machine, so that said components separate and release conditioner held in them into the rinse water.

7. A container for holding clothes conditioners and the like, said container being of a frangible material, and thermally responsive means affixed to said container, said means having been processed so that it changes shape at about 60 degrees F or below to rupture said container to release said conditioners.

8. The invention of claim 7 wherein the thermally responsive means is metallic.

9. The invention of claim 8 wherein the thermally responsive means is a nickel-titanium alloy.

10. The invention of claim 9 wherein the alloy is NITINOL

11. The invention of claim 7 wherein the thermally responsive means is plastic.

12. The invention of claim 12 wherein the plastic is one or more cross-linkable polymeric materials such as polyethylene (PE), PE copolymers, PVC, elastomers, blends of elastomers and PVC, EVA and EVA/wax blends

13. A container for clothes conditioner(s) and the like, said container comprising at least two components of substantially rigid materials which are held together by frictional engagement at room temperature and wherein the components comprise different materials having substantially different coefficients of linear expansion, whereby one of said components contracts so much more than the other component in the cold rinse water of a washing machine that the components detach and release conditioner(s) into the rinse water of the washing machine.

14. The invention of claim 13 wherein at least one of said components is made of plastic.

15. The invention of claim 13 wherein at least one of said components is metal.

16. A container for clothes conditioner(s) and the like, having at least two substantially rigid components which are held together by frictional engagement at room temperature, one of said components having a greater coefficient of linear expansion than the other of said components, whereby one component contracts so much more than the other in cold rinse water that the components detach from each other when the container is in the cold rinse water of a washing machine, whereby the conditioner(s) are released into the rinse water.

17. The invention of claim 16 where the container comprises at least two hemispherical components.

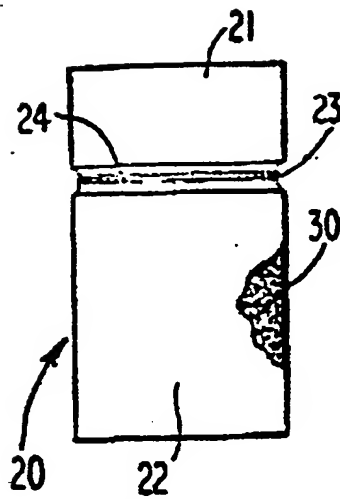


Fig. 1

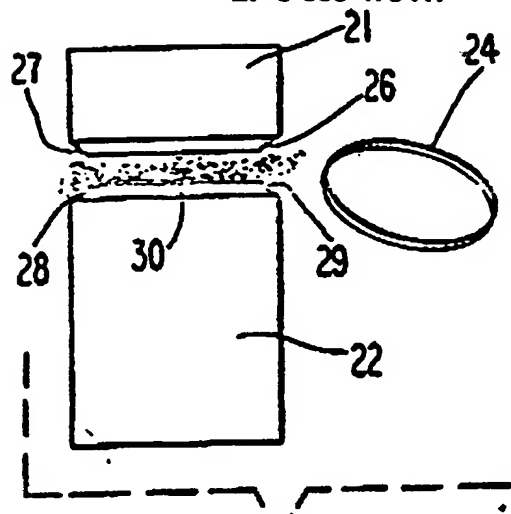


Fig. 2

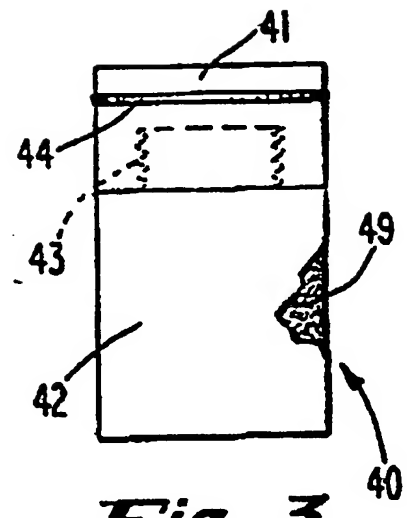


Fig. 3

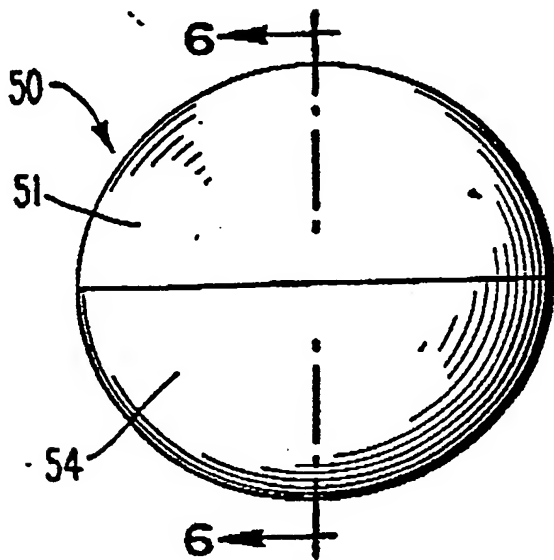


Fig. 5

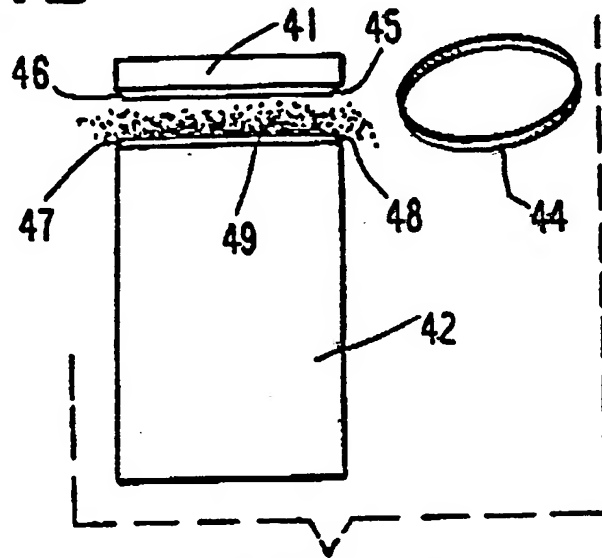


Fig. 4

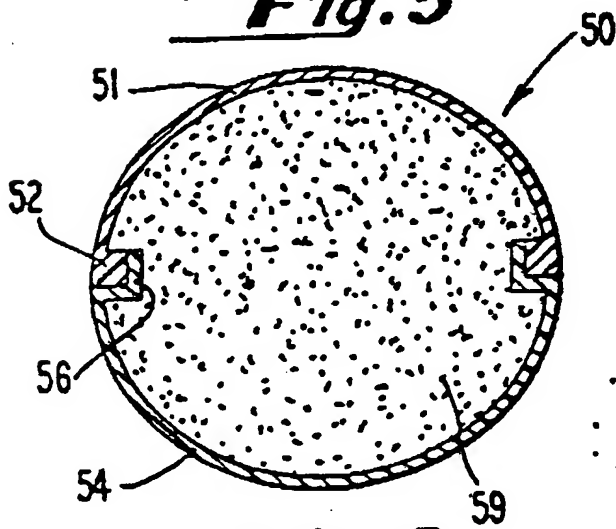


Fig. 6

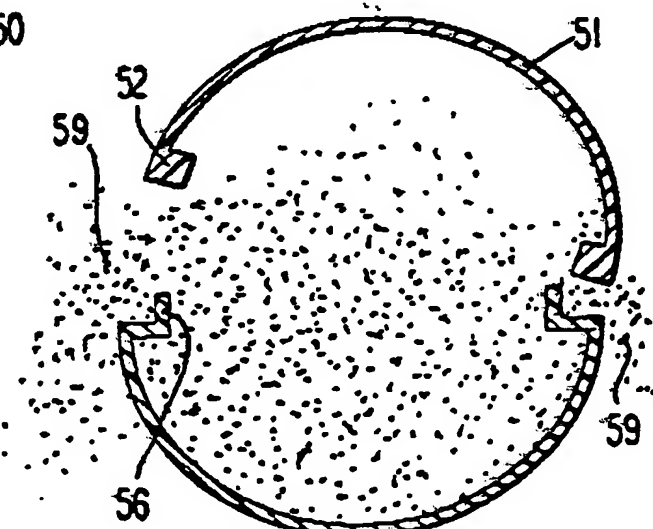


Fig. 7

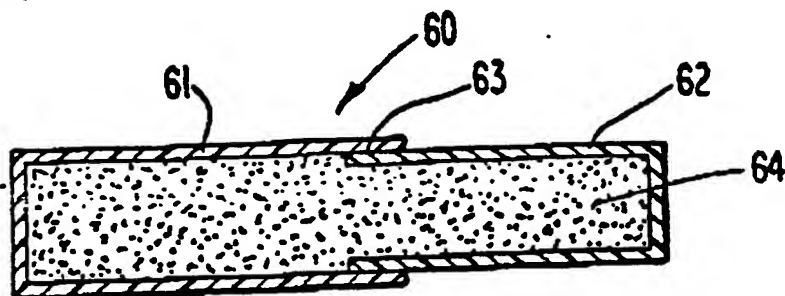


Fig. 8

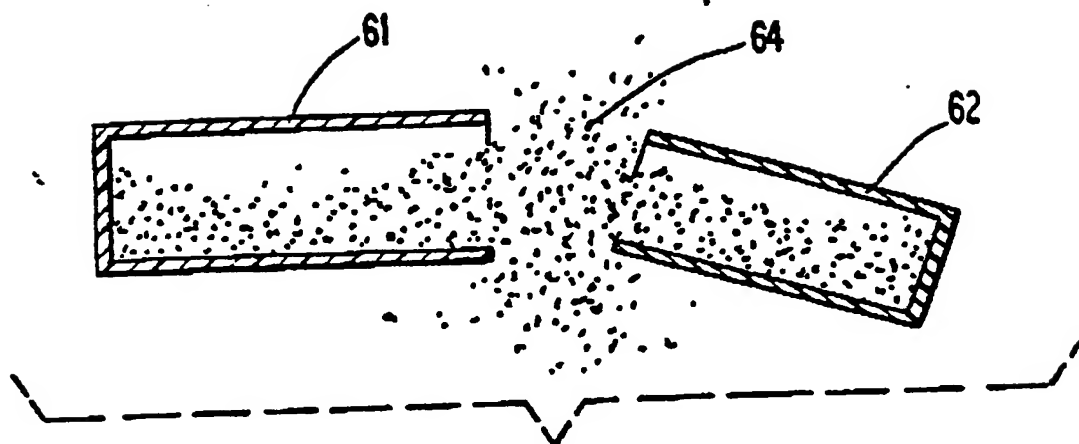


Fig. 9

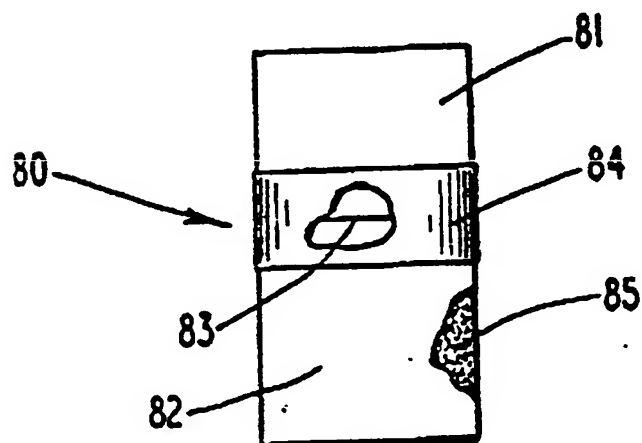


Fig. 10

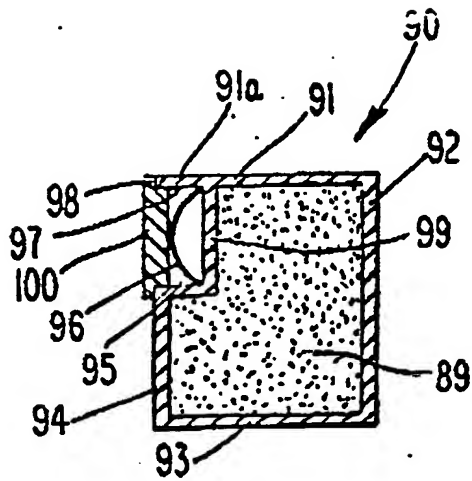


Fig. 11

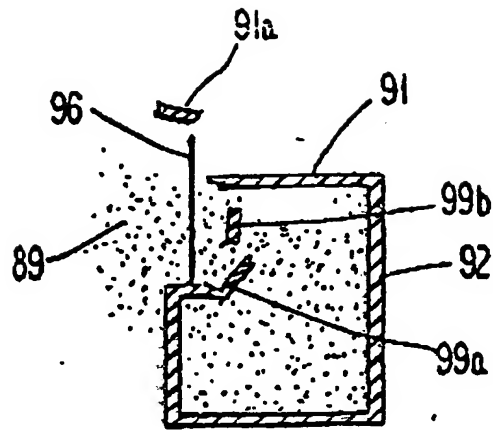


Fig. 12

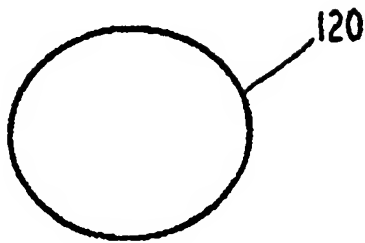


Fig. 13

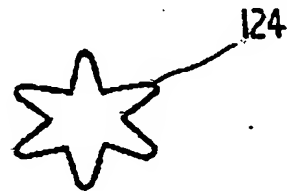


Fig. 14

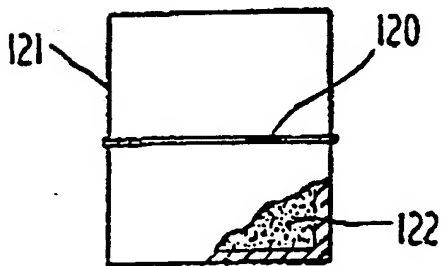


Fig. 15

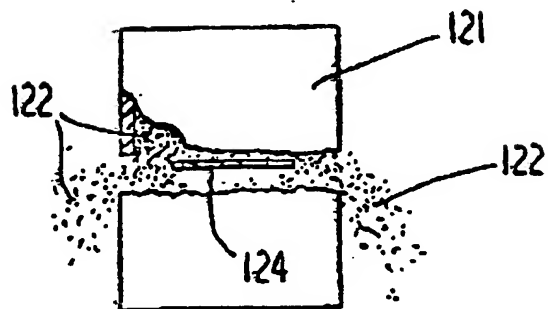


Fig. 16



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 30 3185

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL.5)
A	US-A-3215311 (M. NISON) * column 3, line 59 - column 4, line 46; figures 1-5, 7 *	1, 5, 7	D06F39/02
A	US-A-3108722 (THE PROCTER & GAMBLE COMPANY)		
A	US-A-3399806 (THE PROCTER & GAMBLE COMPANY)		
			TECHNICAL FIELDS SEARCHED (Int. CL.5)
			D06F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 JUNE 1990	Examiner COURRIER G. L. A.
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